PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of

Takaaki CHOSOKABE, et al.

Appln. No.: 10/724,253

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Group Art Unit: 1751

Examiner: Kallambella M. Vijayakumar

For: SINTERED BODY FOR THERMISTOR DEVICES, THERMISTOR DEVICE AND TEMPERATURE SENSOR

DECLARATION UNDER 37 C.F.R. § 1.132

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
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Sir:

I, Takaaki CHOSOKABE, declare and state as follows:

I graduated from Nagoya Institute of technology in March of 1993, receiving a Bachelor's Degree in the Department of Material Engineering. Since April of 1993 to the present, I have been employed by NGK SPARK PLUG CO., LTD., where I have been engaged in the research and development of temperature sensors.

I am co-inventor of the invention described and claimed in the above-identified application.

I am familiar with the Office Action dated November 2, 2006, where claims 1-4 and 8 were rejected as being anticipated by U.S. Patent No. 5,403,461 to Tuller.

First, I explain why I believe my invention defines novel subject matter. Secondly, I report below on comparative experimentation that was conducted by myself or under my direct supervision. The test results demonstrate that the presence of a transition metal other

than Mn and the at least one element selected from elements of Group 3 in the Periodic Table adversely affects the temperature detection performance of the thermistor device over a wide temperature range from a low temperature of around 100°C to a high temperature range of 900°C. Tuller et al., which discloses incorporating transition elements other Mn and the at least one element selected from elements of Group 3 in the Periodic Table, such as Cr, Fe, Co, Ni, Cu, Ti, Zr and Hf, did not recognize this characteristic feature of my invention. For these reasons, not only does my invention define novel subject matter, it is also patentable over Tuller et al.

1. Novelty with Respect to Tuller et al.:

Tuller et al. at column 5 broadly characterizes the solid solution as being represented by the Formula $(A_{1-j}D_j)_x(B_{1-k}E_k)_yO_zX_w$. My claims exclude La, yet this is expressly allowed by the broad formula of Tuller et al. Likewise, my claims exclude any transition metal other than Mn and the at least one element selected from Group 3, yet the broad formula of Tuller et al. allows for the presence of a plurality of transition elements such as Cr, Fe, Co, Ni, Cu, Ti, Zr and Hf in addition to Mn. Moreover, there is nothing in Tuller et al. which would lead one of ordinary skill to select the narrow range of compositions covered by my claims. I understand that under U.S. practice, a broadly overlapping formula of the prior art is not novelty destroying where the prior art also does not lead one skilled in the art to arrive at the claimed subject matter. In my opinion, this is surely the case here. If the Examiner were correct, then no one could obtain a new patent on a thermistor device because Tuller et al.'s broad disclosure at column 5 covers nearly all potential compositions for use in making a sintered body for a thermistor device.

On the other hand, if Tuller et al. did direct one skilled in the art to exclude La, which they do not, and if Tuller et al. did direct one skilled in the art to exclude transition metals other than Mn and the at least one element selected from elements of Group 3 in the Periodic Table, which they also do not, then the Examiner's position would be understandable. However, that is not the case, and for at least these reasons, the sintered body for thermistor devices as claimed in my application defines novel subject matter.

2. Comparative Experimentation:

Sintered bodies were prepared including a Group 3 element selected from Y, Sm, Nd and Gd; a Group 2 element selected from Ca and Sr; Mn and Al in the indicated amounts; and one of Fe and Ni (i.e., a transition metal other than Mn and the at least one element selected from elements of Group 3 excluding La). The samples thus prepared were evaluated with respect to initial electrical resistance at 100°C and 900°C, electrical resistance after heating at 100°C and 900°C and the change in electrical resistance in terms of temperature (°C) as described at pages 25-27 of my specification, the results of which are set forth in the Table below. Particularly, the change in electrical resistance in terms of temperature is calculated in accordance with Formula (3) at page 26 of my specification. A smaller value represents a smaller change in resistance to a heat profile and is therefore advantageous in promoting high temperature detection accuracy.

Comparative Example 7 of composition (YCa)(MnAl**Fe**) having a change in electrical resistance in terms of temperature (°C) of 13 and 15 at 100°C and 900°C, respectively, is directly comparable to Inventive Examples 1 to 15 of my specification having the composition (YCa)(MnAl), each exhibiting a small change in electrical resistance to the heat

profile, namely, ±10°C over the entire temperature range as shown in Table 7 at page 30 of my specification.

Comparative Example 8 having the composition (SmSr)(MnAl**Fe**) is directly comparable to inventive Example 16 having the composition (SmSr)(MnAl). As shown in Table 7 at page 30 of my specification, Inventive Example 16 had a very small change in electrical resistance to the heat profile, whereas Comparative Example 3 further containing a small amount of Fe exhibited a large change in electrical resistance to the heat profile exceeding ±10°C over the entire temperature range.

Comparative Example 9 having the composition (NdSr)(MnAl**Fe**) is directly comparative to Inventive Example 20 of the specification having the composition (NdSr)(MnAl). As shown in Table 7 at page 30 of my specification, inventive Example 20 exhibited a very small change in electrical resistance to the heat profile, whereas Comparative Example 9 having the same composition but further containing a small amount of Fe exhibited a large change in electrical resistance to the heat profile exceeding ±10°C over the entire temperature range.

Comparative Example 10 having the composition (GdSr)(MnAl**Fe**) is directly comparative to Inventive Example 21 having the composition (GdSr)(MnAl). As shown in Table 7 at page 30 of my specification, inventive Example 21 exhibited a very small change in electrical resistance to the heat profile, whereas Comparative Example 10 further containing a small amount of Fe exhibited a large change in electrical resistance to the heat profile, namely, in excess of ±10°C over the entire temperature range.

Comparative Example 11 shows that the composition (NdCa)(MnAl**Fe**) also exhibits a large change in electrical resistance to the heat profile exceeding ±10°C over the entire

temperature range. Comparative Example 12 likewise shows that addition of Ni in place of Fe likewise results in a very large change in electrical resistance to the heat profile.

The test data discussed above is summarized in the Table below.

	Comparative Examples	element of group 3				element of group 2			Mn	Al	Fe	Ni	SiO_2	initial electrical resistance (kΩ)		electrical resistance after heating (kΩ)		Change in electrical resistances in terms of temperature (℃)	
		Y	Sm	Nd	Gd	Sr	Ca	Mg						100℃	900℃	100℃	900℃	100℃	900℃
6	(YSr)(MnAlFe)	0.920	–	–	–	0.080	–	–	0.105	0.865	0.030	–	–	1547	0.150	1046	0.141	11	17
7	(YCa)(MnAlFe)	0.920	–	–	–	–	0.080	–	0.105	0.865	0.030	–	–	1980	0.196	1244	0.185	13	15
8	(SmSr)(MnAlFe)	–	0.920	–	–	0.080	–	–	0.114	0.800	0.086	–	–	4148	0.064	2649	0.058	11	22
9	(NdSr)(MnAlFe)	–	–	0.920	–	0.080	–	–	0.114	0.800	0.086	–	–	2726	0.066	1759	0.061	11	20
10	(GdSr)(MnAlFe)	–	–	–	0.920	0.080	–	–	0.114	0.800	0.086	–	–	2735	0.108	1693	0.102	12	15
11	(NdCa)(MnAlFe)	–	–	0.920	–	–	0.080	–	0.163	0.800	0.038	–	–	3489	0.122	1965	0.111	15	24
12	(YSr)(MnAlNi)	0.920	–	–	–	0.080	–	–	0.120	0.820	–	0.060	–	2113	0.079	1076	0.070	18	30

	Inventive Examples	element of group 3				element of group 2			Mn	Al	Fe	Ni	SiO_2	initial electrical resistance (kΩ)		electrical resistance after heating (kΩ)		Change in electrical resistances in terms of temperature (℃)	
		Y	Sm	Nd	Gd	Sr	Ca	Mg						100℃	900℃	100℃	900℃	100℃	900℃
1	(YCa)(MnAl)	0.820	–	–	–	–	0.180	–	0.180	0.820	–	–	–	4.033	0.059	3.656	0.059	7	1
2	(YCa)(MnAl)	0.820	–	–	–	–	0.180	–	0.180	0.820	–	–	–	303.6	0.186	311.0	0.191	-1	-8
3	(YCa)(MnAl)	0.820	–	–	–	–	0.180	–	0.194	0.806	–	–	–	38.77	0.103	33.54	0.101	8	6
4	(YCa)(MnAl)	0.820	–	–	–	–	0.180	–	0.206	0.794	–	–	–	37.35	0.078	31.49	0.076	10	8
5	(YCa)(MnAl)	0.820	–	–	–	–	0.180	–	0.219	0.781	–	–	–	25.15	0.050	21.80	0.050	8	3
6	(YCa)(MnAl)	0.806	–	–	–	–	0.194	–	0.194	0.806	–	–	–	20.63	0.095	21.33	0.097	-2	-9
7	(YCa)(MnAl)	0.794	–	–	–	–	0.206	–	0.206	0.794	–	–	–	16.94	0.067	18.02	0.068	-3	-8
8	(YCa)(MnAl)	0.781	–	–	–	–	0.219	–	0.219	0.781	–	–	–	9.625	0.051	9.268	0.051	2	3
9	(YCa)(MnAl)	0.840	–	–	–	–	0.160	–	0.180	0.820	–	–	–	189.7	0.139	167.8	0.140	5	-2
10	(YCa)(MnAl)	0.840	–	–	–	–	0.160	–	0.194	0.806	–	–	–	125.4	0.109	97.19	0.107	10	5
11	(YCa)(MnAl)	0.840	–	–	–	–	0.160	–	0.206	0.794	–	–	–	212.7	0.081	158.3	0.080	10	3
12	(YCa)(MnAl)	0.840	–	–	–	–	0.160	–	0.219	0.781	–	–	–	73.05	0.055	56.0	0.054	10	6
13	(YCa)(MnAl)	0.940	–	–	–	–	0.060	–	0.180	0.820	–	–	–	1703	0.182	1735	0.186	-1	-6

	Inventive Examples	element of group 3				element of group 2			Mn	Al	Fe	Ni	SiO_2	initial electrical resistance (kΩ)		electrical resistance after heating (kΩ)		Change in electrical resistances in terms of temperature (°C)	
		Y	Sm	Nd	Gd	Sr	Ca	Mg						100°C	900°C	100°C	900°C	100°C	900°C
14	(YCa)(MnAl)	0.940	–	–	–	–	0.060	–	0.219	0.781	–	–	–	512.4	0.082	471.0	0.082	2	0
15	(YCa)(MnAl)	0.960	–	–	–	–	0.040	–	0.180	0.820	–	–	–	1985	0.251	1810	0.247	3	4
16	(SmSr)(MnAl)	0.960	0.820	–	–	0.180	–	–	0.180	0.820	–	–	–	222.9	0.085	203.2	0.085	3	1
17	(Ysr)(MnAl)	0.940	–	–	–	0.060	–	–	0.180	0.820	–	–	–	103.0	0.195	92.32	0.197	5	-3
18	(Ysr)(MnAl)	0.940	–	–	–	0.060	–	–	0.145	0.855	–	–	–	31.26	0.101	30.28	0.100	1	5
19	(Ysr)(MnAl)	0.940	–	–	–	0.040	–	–	0.254	0.746	–	–	–	5.474	0.023	6.098	0.024	-5	-6
20	(NdSr)(MnAl)	–	–	0.820	–	0.180	–	–	0.180	0.820	–	–	–	151.5	0.087	143.0	0.086	2	5
21	(GdSr)(MnAl)	–	–	–	0.82	0.180	–	–	0.180	0.820	–	–	–	142.6	0.143	125.0	0.139	5	8

In summary, the test data presented herein demonstrates that the presence of a transition metal other than Mn and the at least one element selected from elements of Group 3 in the Periodic Table excluding La results in a large change in electrical resistance to the heat profile, namely, in excess of ±10°C over the entire temperature range. On the other hand, by excluding any transition metal other Mn and the at least one element selected from Group 3, in accordance with my invention, there is a small change in electrical resistance to the heat profile, namely, well within ±10°C over the entire temperature range. Tuller et al., which discloses and allows for incorporation of transition elements other Mn and the at least one element selected from elements of Group 3 in the Periodic Table, such as Cr, Fe, Co, Ni, Cu, Ti, Zr and Hf, did not recognize this characteristic feature of my invention.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Date: 1/31/2007

Takaaki Chosokabe